On the Nature **of Io's Thermal** Reservoir Unit

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For more than twenty years Io's bizarre thermal emission spectrum has remained a challenge for modeling. The discovery of volcanic thermal anomalies on Io's surface (Hanel et al., 1979) allowed explanation of many, but not all, of Io's thermal features. The use of proven thermophysical modeling (Sinton and Kaminsky; McEwen et al., 1988) offered initial hope. But as accurate information from Voyager was developed and included in the models, none were fated to succeed. Io's predicted 20pm emission from standard models is about a factor of two larger than observed, even before inclusion of additional emission due to the thermal anomalies! In our work, we have developed a new modeling approach for explaining Io's emission. Unusual features of this model include: (1) significant nighttime re-radiation of absorbed sunlight due to heat storage in a reservoir unit, and (2) the thermal pedestal effect which is the blue -shifted, re-radiation of insolation absorbed by thermal anomalies. The new model accurately and simultaneously accounts for Io's low 20pm emittance and the in-and-out-of-eclipse radiometry at 4.8, 8.7, and 20μm. A favorable feature of the model is that the physics of the thermal pedestal effect is simple and was clearly an omission in earlier models. However, the exact physical nature of the reservoir unit remains to be understood. There are three processes which can meet the available constraints, These involve (1) thermal inertia, (2) solid-state greenhouse, and (3) latent heat due to volatiles. The possibilities for using 2 and 3 should be obvious. The possibility of a relatively high thermal inertia is one which has just been revitalized. The available estimates of Io's thermal inertia did not take into account the thermal pedestal effect. This effect has a temporal signature which mimics, at least in part, the eclipse cooling behavior from which all of the thermal inertias were inferred. (This work was done at JPL/Caltech, under contract to NASA.)

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